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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
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| 10/808,110 | 03/24/2004 | Yuan Yu | 225671 | 4171 |
| 41505 7590 01/11/2008 WOODCOCK WASHBURN LLP (MICROSOFT CORPORATION) CIRA CENTRE, 12TH FLOOR 2929 ARCH STREET PHILADELPHIA, PA 19104-2891 | | | EXAMINER ZHE, MENG YAO | |
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary

Application No.

10/808,110

Applicant(s)

YU, YUAN

Examiner

MengYao Zhe

Art Unit

2195

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 24 March 2004.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-21 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-21 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 24 March 2007 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date <u>See Continuation Sheet</u> . | 6) <input type="checkbox"/> Other: _____ |

Continuation of Attachment(s) 3). Information Disclosure Statement(s) (PTO/SB/08), Paper No(s)/Mail Date :8/31/07, 5/25/05, 4/9/04, 3/24/04.

DETAILED ACTION

1. Claims 1-21 are presented for examination.

Claim Rejections - 35 USC § 101

2. 35 U.S.C. 101 reads as follows:

Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

3. Claims 16-18, are rejected under 35 U.S.C. 101 because it recites a "system"; however, it appears that the system would reasonably be interpreted by one of ordinary skill in the art as software, per se, failing to be tangibly embodied or include any recited hardware as part of the system.

Claim Rejections - 35 USC § 112

4. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

5. Claims 1-21 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

A. The following terms lack antecedent basis:

i) Claim 12, line 5, "the set containing thread segments..."

line 7, "the singleton set"

B. The following claim languages are unclear and indefinite:

i) Claim 4, it is uncertain what the relationship is between "each shared memory location" of lines 4, 7 and "the location" of line 5 <i.e. is the location referring to shared memory location? If so, consistent names should be used>.

It is not clearly understood what the relationship is between "a set of concurrent thread segments" of line 6 and "a plurality of threads" of line 2 <i.e. is a set of concurrent thread segments part of a plurality of threads? Furthermore, what is the difference between a set of concurrent threads and a set of concurrent thread segments?>

Lines 5-6, it is unclear as to how "maintaining a first set of locks" and "maintaining a set of concurrent thread segments" are performed <i.e. what is meant by maintaining? what is specifically being done? Is it ordering the threads on a first come first serve basis? Are the threads with its associated locks put into a queue?>. Furthermore, it is uncertain as to why there are a plurality of locks in

a first set of locks associated with the location < i.e. why does a memory location need multiple locks? Does each thread get a lock?>.

It is unclear how "a second set of locks" of line 9 are related to "a first set of locks" of line 5 <i.e. are the two sets mutually exclusive? Why are there two sets in the first place? What is their purpose?>

Lines 9-10, it is uncertain how a second set of locks are maintained <i.e. what is specifically being done? Does a lock get added to the second set when a thread acquires a lock? Does the same lock get deleted from the set when that thread releases the lock?>

Lines 11-12, it is unclear as to what the difference is between "the current thread segment of the thread" and simply "the thread" <i.e. why are there two different names given? What is the distinction?>

It is uncertain how the method mentioned in this claim may help to detect "a potential race condition in a program" as stated in the preamble <i.e. What are the purposes of the two locks? How are they suppose to help to detect any race conditions?>

Claim 1 has the same deficiencies as claim 4 above.

ii) Claim 5, it is not clearly understood as to what "a virtual clock" does <i.e. is it helping to time the execution period of each thread or thread's waiting time on a lock?>.

iii) Claim 12, line 2, it is uncertain as to what is meant by "a first thread joins a forked thread" <i.e. How does a thread join a forked thread? Do they become one thread? What happens?>.

iv) Claim 13, it is not clearly understood as to how "the set containing the thread segments" can possibly comprise "a set containing the ordered pairs" <i.e. if it is a set of threads, then how can a bunch of thread contain ordered pairs? They are not the same objects.>

v) Claim 15, lines 7-8, it is uncertain how "the virtual clock value of a" may become "greater than the virtual clock value of b" <i.e. Under what circumstances does this happen? How does the clock value gets changed? Claim 9 explains how this could happen, however, claim 15 does not depend on claim 9.>

vi) Claim 16, lines 2-3, it is uncertain how "a compiler" is related to "compiled code" < i.e. Was the compiled code compiled by the compiler of a runtime system?>

lines 4-5, it is uncertain what "shared memory objects instrumentation information" is <i.e. what is this? What does it do?>

Claim 19 has the same deficiencies as claim 16 above.

Claim Rejections - 35 USC § 102

6. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

7. Claims 1, 4, 16-17, 19-21 are rejected under 35 U.S.C. 102(e) as being unpatentable over Tudor, Patent No. 6,920,634 (hereafter Tudor).

8. As per claims 1, 4, Tudor teaches a computer-implemented method for dynamically detecting a potential race condition in a program having a plurality of threads and one or more shared memory locations (Column 1, line 67; Column 2, lines 1-2), the method comprising:

with respect to each shared memory location, maintaining a first set of locks associated with the location, and maintaining a set of concurrent thread segments that access the location (Column 2, lines 1-7; Column 8, lines 35-43);

with respect to each thread, maintaining a second set of locks that are acquired and released by the thread (Column 2, line 12; Column 8, lines 36-43), and maintaining

a set of thread segments that are ordered before the current thread segment of the thread (Fig 6; Column 2, lines 61-65; Column 5, lines 63-67; Column 6, lines 22-33).

9. As per claims 16, 19, Tudor teaches a computer-implemented method for dynamic race detection (Col 1, lines 66-67), comprising: by way of a compiler of a runtime system, inserting calls to a race detector in compiled code (Column 4, lines 61-67; Column 5, lines 1-22); and by way of a memory allocator of the runtime system, adding instrumentation information required by the race detector to shared memory objects (Column 5, lines 12-22; Column 6, lines 52-61).

10. As per claims 17, 20, Tudor teaches wherein inserting the calls to the race detector is by way of modifying the compiler of the runtime system (Column 4, lines 61-67; Column 5, lines 1-22).

11. As per claim 21, Tudor teaches wherein adding the instrumentation information required by the race detector is by way of changing the memory allocator of the runtime system (Column 5, lines 12-22; Column 6, lines 52-61).

Claim Rejections - 35 USC § 103

12. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

13. Claims 2-3, 5-15, 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tudor, Patent No. 6,920,634 (hereafter Tudor).

14. As per claim 5, Tudor teaches using a clock to time the amount of waiting time of a thread (Column 6, lines 43-46).

Tudor does not specifically teach with respect to each thread, maintaining a virtual clock associated with the thread.

It would have been obvious to one having ordinary skill at the time of the applicant's invention to modify the teachings of Tudor, where a clock is used to time the waiting time of a thread, with a virtual clock used for each thread, such that a clock may be used for each thread to calculate waiting time.

15. As per claims 6, 7, Tudor does not specifically teach wherein maintaining the virtual clock comprises initializing the virtual clock to zero when the thread is created.

However, it would have been obvious to one having ordinary skill in the art at the time of the applicant's invention to initialize the timer to any amount, including zero, in order to calculate the amount of waiting time.

16. As per claims 2, 3, 8, 11, Tudor teaches maintaining the set of thread segments that are ordered before the current thread segment of the thread in order to track the execution order of threads (Column 2, lines 61-65; Column 5, lines 63-67; Column 6, lines 22-33).

Tudor does not specifically teach maintaining a set of ordered pairs, wherein one member of a pair is a thread identifier, and the other member of the pair is a virtual clock value.

However, it would have been obvious to one having ordinary skill in the art at the time of the applicant's invention to modify the teachings of Tudor with maintaining a set of ordered pairs, wherein one member of a pair is a thread identifier, and the other member of the pair is a virtual clock value since it allows for tracking execution order of threads.

17. As per claims 9, 12, 13, Tudor does not specifically teach if a first thread forks a second thread: computing the set of thread segments that are ordered before the current thread segment of the second thread as the union of (a) the set of thread segments that are ordered before the current thread segment of the first thread and (b) a singleton set containing the current thread segment of the first thread; incrementing the virtual clock associated with the first thread, and initializing the virtual clock associated with the second thread.

However, it would have been obvious to one having ordinary skill in the art at the time of the applicant's invention to modify the teachings of Tudor with if a first thread forks a second thread: computing the set of thread segments that are ordered before the current thread segment of the second thread as the union of (a) the set of thread segments that are ordered before the current thread segment of the first thread and (b) a singleton set containing the current thread segment of the first thread; incrementing the virtual clock associated with the first thread, and initializing the virtual clock associated with the second thread since this is analogous to asking the question of if mother A has her parents and grandparents born before her, and if mother A produces child B, who would be ordered before child B. It would have been obvious for anyone to clearly see that mother A and her parents and grandparents are ordered before child B.

18. As per claim 10, Tudor does not specifically teach wherein incrementing the virtual clock associated with the first thread comprises incrementing the virtual clock associated with the first thread by one.

However, it would have been obvious to one having ordinary skill in the art at the time of the applicant's invention to modify the teachings of Tudor with incrementing the virtual clock associated with the first thread comprises incrementing the virtual clock associated with the first thread by one in order to track forking and ordering.

19. As per claim 14, Tudor teaches if a thread accesses a shared memory location: updating the set of concurrent thread segments that access the location by forming a set comprising the union of (a) a set containing the current thread segment of the thread, and (b) a set containing the thread segments in the set of concurrent thread segments that continue to access the location; and if the updated set of concurrent thread segments contains at most one element, then updating the set of locks associated with the location to the set of locks associated with the thread, and otherwise: (i) updating the set of locks associated with the location to a set comprising the intersection of (a) the set of locks associated with the location and (b) the set of locks associated with the thread, and (ii) if the set of locks associated with the location is empty, reporting a warning of a potential race condition (Column 2, lines 33-52; Column 8, lines 35-60).

20. As per claim 15, Tudor does not specifically teach wherein the set containing the thread segments in the set of concurrent thread segments that continue to access the location is formed by computing a subset of the set of concurrent thread segments, wherein the subset contains each thread segment a that satisfies the following predicate: for every thread segment b in the set of thread segments ordered before a, at least one of the following is true: (i) the thread identifier of a is not equal to the thread identifier of b and (ii) the virtual clock value of a is greater than the virtual clock value of b.

However, it would have been obvious to one having ordinary skill in the art at the time of the applicant's invention to modify the teachings of Tudor with wherein the set containing the thread segments in the set of concurrent thread segments that continue to access the location is formed by computing a subset of the set of concurrent thread segments, wherein the subset contains each thread segment a that satisfies the following predicate: for every thread segment b in the set of thread segments ordered before a, at least one of the following is true: (i) the thread identifier of a is not equal to the thread identifier of b and (ii) the virtual clock value of a is greater than the virtual clock value of b since this specific step allows one to further refine the set for more accurate race prediction.

21. As per claim 18, Tudor does not specifically teach wherein the memory allocator is an alteration of another memory allocator.

However, it would have been obvious to one having ordinary skill in the art to have the memory allocator contain any types of characteristic, including having it be an alteration of another memory allocator since this characteristic does not contribute to the importance this the applicant's invention.

Conclusion

22. Any inquiry concerning this communication or earlier communications from the examiner should be directed to MengYao Zhe whose telephone number is 571-272-6946. The examiner can normally be reached on Monday Through Friday, 7:30 - 5:00 EST. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Meng-Ai An can be reached at 571-272-3756. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.


MENG-AI. AN
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2100